MTM

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The Journal of Methods-Time Measurement

MTM ASSOCIATION FOR STANDARDS AND RESEARCH

May-June

1956

Vol. III

No. 2

In This Issue . . .

Background of Predetermined Time Systems

MTM's Part in Establishing Assembly Methods for Incentive Purposes

Time Formula Applied to Machining Operations

Dayton Air Force Depot Graduates MTM Practitioners

The Journal of Methods-Time Measurement is dedicated to the technical aspects, application developments and general news items concerning the advancement of MTM.

The Journal encompasses the fields of endeavor that were formerly publicized in the MTM Newsletter and MTM Bulletin.

The technical section of the Journal is concerned chiefly with recent research developments both from the established research program at the University of Michigan, Ann Arbor, Michigan, and from somewhat smaller allied projects being conducted throughout the Association membership.

New applications of MTM as well as refinements of established applications are presented in the Application Section to illustrate specific approaches to management problems that can be solved through the use of Methods-Time Measurement.

Current events in the lives of persons associated with MTM are described in the general news section.

The Editorial Staff welcomes contributions for all three sections described.

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CONTENTS

Feature

Background of Predetermined Time Systems 2
D. W. Karger, Chief Plant and Industrial Engineer
The Magnavox Company
Fort Wayne, Indiana

Application

I. MTM's Part in Establishing Assembly Methods for Incentive Purposes 7
Charles A. Bogenrief, Department Head of Industrial and Plant Engineering, Grayson Controls Division
Robertshaw-Fulton Controls Company, Long Beach, California

II. Time Formula Applied to Machining Operations 16
W. Holmes

MTM News

Dayton Air Force Depot Graduates MTM Practitioners 28

Chapter News

Central Iowa Association 28
Cincinnati Ohio Chapter 28
Southern California Chapter 28
St. Louis Chapter 28
Toronto Chapter 28

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Editor's Note:

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DAYTON AIR FORCE DEPOT GRADUATES MTM PRACTITIONERS

Reading left to right: Lt. Carl J. Wyles receives certificate and is congratulated by Colonel Leon W. Armour, (right), Deputy Commander at the Dayton Air Force Depot, in the presence of Mr. John West (center), Instructor, on the successful completion of the Methods Time Measurement Practitioner's Course. Back Row (left to right): Lt. Otis T. Blake, Lowell E. Mesarvey, Jr., Robert Sutton, Alvin J. Bonham, Jean Cassel, John Leiser, James H. Hannegan, Edwin Durr, and Dallas T. Huddle. Gerald B. Hanby was not present for the presentation. Story on page 28.

FEATURE

BACKGROUND OF PREDETERMINED TIME SYSTEMS

D. W. Karger
Chief Plant and Industrial Engineer
The Magnavox Company
Fort Wayne, Indiana
before
Second Annual Industrial Engineering Conference
A.I.I.E., Fort Wayne, Indiana
April 26, 1956

The search for a better way to do things has progressed since the birth of mankind. The inventor of the wheel, undoubtedly, was motivated by a desire to eliminate some of the hard work involved in dragging things about on a travois.

Likewise, industry from its earliest beginnings, has always been concerned with manufacturing methods. The interest is greatest during periods of low profit and severe competition. It is less during times of high profit, which may be a factor in causing economic down-swings.

In the 19th and the early part of this century, Taylor, Gantt, the Gilbreths, Emerson and others originated the scientific management concept. They introduced and developed many new principles of management together with techniques designed to systematize and standardize the planning, operation and control of industry.

These men were primarily concerned with the workers. Basic to the implementing of many of these progressive steps was the establishment of an adequate basis for work measurement. The evolution of better methods has been rapid ever since the establishment of work measurement techniques and procedures.

Dr. Frederick W. Taylor is generally known as the father of scientific management. He is responsible for the first definitive approach to work measurement. He approached this problem on the basis that one cannot scientifically manage something that they cannot measure. He set up a method of objectively measuring human performance.

Few people realize how far back in time the measurement of human performance in industry dates. Please note that it was in 1885 that Dr. Taylor was made a foreman of the Midvale Steel Company near Philadelphia and began his work on this subject.

It is believed that most of us know of Dr. Taylor's activity from this point on, however, a short review might be in order. His first efforts involved the establishment of production levels based on past performance records. He soon realized that these standards, based on the same poor performance that he wanted to eliminate would not be satisfactory. His next step was to use the stop watch to time elements of operations.

Dr. Taylor was not the first to use a stop watch. I know of one instance as early as 1760, when M. Coulomb used a watch to time operation elements for industrial planning purposes. Taylor, however, developed a full technique for standardizing performance times by using a stop watch together with a specific and detailed procedure.

Soon after Dr. Taylor began his work, Mr. Frank B. Gilbreth decided to leave the construction field, and in which he had been a successful building contractor, to devote his time to the study of methods as they are related to scientific management. The Gilbreth story is even more common than that of Dr. Taylor and no elaboration should be required. The Gilbreths emphasized the method, whereas Taylor appeared to emphasize time. Both Taylor and Gilbreth won many followers, however, this following resulted in the development of two groups who considered themselves irrevocably opposed to each other. This lasted roughly from 1910 to 1930. One group was known as the Time Study Group and the other as the Motion Study Group.

Eventually, the groups became better acquainted and found that they really differed little in their fundamental approaches. This ultimately resulted in combining the best features of both procedures into what is known today as Methods Engineering.

Reference has been made to the fact that time study is not a recent development. This is further emphasized by a study of scientific management made for the United States Commission on Industrial Relations in 1914 by Mr. Robert Franklin Hoxie. Mr. Hoxie listed in 1914 some seventeen factors in time study practice which at that time could be varied, subject to human will. These factors enter into time study standards today the same as they did in 1914. His seventeen factors are as follows:

1. The general attitude, ideals, and purposes of the management and the consequent general instruction given to the time study man.
2. The character, intelligence, training, and ideals of the time study man.
3. The degree to which the job to be timed and all its appurtenances have been studied and standardized looking to uniform conditions in its performance for all the workers.
4. The amount of change thus made from old methods and conditions of performance, e.g., the order of performance, the motions eliminated, and the degree of habituation of the workers to the old and the new situation when the task is set.
5. The mode of selection of the workers to be timed and their speed and skill relative to the other members of the group.
6. The relative number of workers timed and the number of readings considered sufficient to secure the result desired.
7. The atmospheric conditions, time of day, time of year, the mental and physical condition of the workers when timed and the judgment exercised in reducing these matters to the "normal."
8. The character and amount of special instruction and special training given the selected workers before timing them.
9. The instructions given to them by the time study man as to care and speed, etc., to be maintained during the timing process.
10. The attitude of the time study man toward the workers being timed and the secret motives and aims of the workers themselves.
11. The judgment of the time study man as to the pace maintained under timing relative to the "proper," "normal," or maximum speed which should be demanded.
12. The checks on the actual results used by the time study man in this connection.
13. The method and mechanism used for observing and recording times and the degree of accuracy with which actual results are caught and put down.
14. The judgment exercised by the time study man in respect to the retention or elimination of possibly inaccurate or "abnormally" high or low readings.
15. The method used in summing up the elementary readings to get the necessary elementary time.
16. The method employed in determining how much should be added to the "necessary time" as a human allowance, and
17. The method of determining the machine allowance.

While many of the factors listed by Mr. Hoxie have been at least partially overcome by better training, more careful adherence to proper procedure, the use of leveling films, etc., time study practice today is still open to active criticism on each of the seventeen factors. That such criticism is of a crucial nature is affirmed by serious strikes, files of grievances, and other positive evidence of time study failure.

Before anyone gets a false impression from the above statements it should be emphasized that I believe time study to be practical and we in our company use it as a very practical and useful industrial engineering tool. In a like manner, we use MTM.

In the early development of the steam engine, designers worked with cylinders 3/8" or more out of round; and it was a real accomplishment when they finally manufactured a 57" cylinder, true within the thickness of an old shilling. Today, designers work in terms of millionths of an inch. As methods of production have improved, the acceptable tolerance in terms of total measurement has been much reduced.

In a similar manner, as production methods have been refined and the work volume per worker increased, standards of work measurement need to be more precise. The preciseness of measurement and the tolerance inherent in normal time study procedure was at one time acceptable, but they are rapidly becoming unacceptable in many applications. This has essentially fostered the development of predetermined time systems.

Perhaps it would be well to journey back to Dr. Taylor. Taylor recognized the relationship existing between methods and time, which was evidenced by his subdividing an operation into time study elements such as: "pick up piece," "place in jig," etc. The Gilbreths refined Taylor's concepts of work elements by further subdivision into therblig elements of transport empty, transport loaded, grasp, use, assemble, etc. The therblig classifications emphasized primarily a better understanding of the composition of normal industrial operations from an operator's standpoint. They were not developed with great concern for the absolute performance time for the therblig elements. The therblig sub-divisions did, however, lead to a classification of elements adequate for what is known today as predetermined time standards.

Resuming the history of work measurement, we need to go back to the period following World War I. The economy of our country expanded and boomed for almost the entire 1920 decade. Industry grew rapidly as a result of an ever-increasing demand for goods and services of every description. This demand in turn brought about the application of promising approaches to work measurement in order that profits might survive in spite of increasing financial pressure, competition, inflation, and general needs for increased production.

Reliable work analysts of both the time study and motion study groups were enlisted. Industry, however, wanted fast answers and it soon became obvious that good analysis took patient long hours of qualified effort and in addition there still existed areas of uncertainty.

As often happens in human affairs, when the need is great, well intentioned, but often unqualified, persons tend to exploit such situations for their own profit. During this period, many "salesmen" with little or real understanding of either management or work measurement grabbed stop watches, "pat" analysis reports, newly created jargon, etc., and worked industry for all they could get. Thus evolved the era of the "efficiency experts." The damage they did repute of work measurement, alienated workers and their unions, and bred many other undesirable effects which still partially persist.

What went wrong? Obviously, adequate and reliable work measurement is a professional activity of high calibre. It was a lack of professional approach that caused most of the trouble. Other things had apparently entered the situation and the more astute practitioners began at this point to seriously analyze the nature of work measurement itself.

The basic precepts of the pioneers themselves pointed the way to the more refined solution. Dr. Taylor insisted that:

1. The right operator be found to permit reliable study.
2. The correct tools should be properly used by the operator.
3. The operator should use the proper motions during performance.
4. Only then should a stop watch be employed to find the task time.
5. No value could accrue from the study unless teaching and enforcing the use of the method on which the time was taken followed the study.

To these guiding lights, the Gilbreths added several other ideas:

1. If the best, least involved, motions are used for a task, the time required will automatically be minimal.
2. Performance times are subject to natural variation and the laws of probability; out of the range of times for a given motion, the most useful value is the mean time. The average operator is most numerous.
3. No work study or other means of specifying job content is adequately done unless the human factors have been considered and humane answers found. Cooperation is superior to coercion.
4. Human beings differ markedly in many ways; but, in the statistical sense, there are points of similarity between all people which permit the discovery of laws of behavior that can predict actions with calculated reliability. The physiological mechanism involved in motion performance is such a point of likeness.

It is logical that attention should be given to both the motions and the elapsed times involved in work performance. This is done in all predetermined time systems. The natural equivalence between motions and times, exhibiting a mathematical relation such that variations for workers with adequate practice tends to be minimal is the basic key to all predetermined time systems.

The credit for first stating this key is generally attributed to Mr. A. B. Segur, who wrote in Manufacturing Industry during 1927 as follows:

"Within practical limits, the time required for all experts to perform true fundamental motions is a constant."

The desirability of predetermining both the basic motions and the time required for an average operator to perform them was indirectly acknowledged almost from the beginning of work measurement. Many noted analysts achieved success by amassing large amounts of standard data for typical jobs. The work of Carl Barth, Harrington Emerson, the Industrial Management Society, and Ralph M. Barnes typified this approach.

A word of caution is in order at this point. Neither a stop watch time study nor motion study with therbligs have been superseded by predetermined time systems. Current methods engineering demands that the most appropriate tool be used for the task at hand. This may involve stop watch time study, time and motion study or the use of a predetermined time system depending upon the situation involved.

Predetermined time systems were rather slow in development. Only about three of them, notably MTA (Methods Time Analysis), Work Factor, and MTS (Motion Time Standards) trace their usage into the 1930-1940 era. Possibly this was in part due to the effects of the depression and its aftermath. The bad taste left by the "efficiency experts" of the 1920's also undoubtedly left its effect. Industrial Engineers had to expend much of their energy and thought to overcome this bad reputation of the "efficiency expert" and this hindered profitable usage of their time in developing new approaches to work measurement.

This situation did not continue. The 1940's brought a rapid war mobilization with shortages of material and man power. It was during this period that several more of the better known predetermined time systems, including MTM, originated. Then, from 1950 to the present time, the predetermined time systems already established, continued a healthy growth as competition reappeared. Additional systems have also come into existence since 1950.

We have discussed predetermined time systems. Just what is a predetermined time system? It is defined as follows: A Predetermined Time System is an organized body of information, procedures, and techniques employed in the study and evaluation of work elements performed by human power, in the terms of the methods, or motions used, their general and specific nature, the conditions under which they occur, and the application of prestandardized or predetermined times which their performance requires.

The definition of Methods-Time Measurement does not vary a great deal from the general definition of a predetermined time system. MTM is officially defined as follows:

Methods-Time Measurement is a procedure which analyzes any manual operation or method into the basic motions required to perform it and assigns to each motion a predetermined time standard, which is determined by the nature of the motion and the conditions under which it is made.

Methods-Time Measurement is the only predetermined time system, whose entire data has been made completely available to the general public. It was developed at the Methods Engineering Council, Pittsburgh, Pennsylvania by Messrs. Harold B. Maynard, Gustave J. Stegemerten and John L. Schwab. These men aided the development of scientific management a great deal by founding with others, a non-profit Research and Development Organization known as the MTM Association for Standards and Research. They assigned all of their data and development rights to this Association. The Association itself, since its founding, has been carrying out further research, approximately $100,000 worth, and thereby, is refining and extending the usage of MTM.

Time permitting, let us explore MTM a bit further. First of all it is an analytical procedure. The procedure's analysis must be accomplished if the time required for the motions made is to be established. Definite steps must be followed to make successful usage of the time data. The fact that analysis cannot be circumvented, if usable results are to accrue from either the method or time viewpoints, is most important. The analysis designed into the MTM system, inherently aids its user to arrive at better methods and lower times for a given task.

The time assigned to each motion does not depend on the operator; it is for the average operator in the universally varying distribution. The element of judgment of performance required by a time study analyst is eliminated and the times established are therefore fully objective.

Finally, the time depends on both the true nature of the motion in question and the conditions of performance imposed on the motion by all other agencies besides the operator involved in the situation.

I have mentioned other predetermined time systems. I would therefore like to leave with you some means of judging their worth. To do this, effectively, nine criteria for judgment of predetermined time systems will be given. They are as follows:

1. The approach and usage of the system should be professional in the best sense of the term. Salesmanship of a system is necessary, but it must be done with a fitting dignity and taste. Human lives are affected and therefore the best professional treatment is required and in order.

2. The system must be based on sound concepts.

3. The data must be validated by both developers and by independent efforts. This validation has occurred with MTM.

4. There should be some form of training control so as to insure that misuse of the system through partial or improper understanding will not endanger a repetition of the "efficiency expert" era.

5. The working form of a good predetermined time system must be practical and practicable to make it adaptable to the solution of many types of work study problems. It must be applicable to a wide range of variation in work content, industrial practices, and worker skills.

6. A good system is easy to use.

7. A good predetermined time system must be maintained in a dynamic condition to meet the challenge of change. Actual work systems are dynamic, changing with the times and new technology. To meet this rule, a continuing program of research is required.

8. A good system has practical emphasis and it must give correct answers. The best means of assuring this facet for predetermined time systems concerns the use of two main data sources. Laboratory data developed under controlled conditions should properly be used only for isolation of the variables, their nature, their inter-relationships, and the approximate numerical limits that they normally exhibit. For the actual application data, however, reliance must be placed on industrial samples of sufficient scope, range, and size to permit valid conclusions.

9. The final feature of a good predetermined time system is universality. Acceptance must be broad, not confined to limits such as special industries, geographical boundaries, or usage by restricted clientele.

I am sure that each of you is intelligent and capable of applying these rules or gauges to judge the worth of any predetermined time system that you are questioning.

A P P L I C A T I O N

I

MTM'S PART IN ESTABLISHING ASSEMBLY METHODS FOR INCENTIVE PURPOSES

Charles A. Bogenrief
Department Head of Industrial and Plant Engineering
Grayson Controls Division
Robertshaw-Fulton Controls Company, Long Beach, California

At the 4th Annual International MTM Conference
Held in Chicago
On October 5th & 6th, 1955

Industrial Engineers are constantly striving to improve the techniques used in establishing better work methods. As a result, when MTM was introduced to industry several years ago it had definite appeal to all of us.

I was considerably impressed by an early article on MTM published by Fortune Magazine. Here a case study on MTM's use in predetermining time standards for a completely conveyorized assembly line was discussed.

By coincidence, this first application was made in the Robertshaw Thermostat Division at Youngwood, Pennsylvania and I had the good fortune of seeing this assembly line in operation a short time after the installation.

Our management became very interested in MTM and began training our engineers in the fall of 1951 and, as I recall, this was the second training session to be held on the West Coast.

Now, before proceeding with the details on our use of MTM, I believe some background information will be helpful so that you can see more clearly our problems before and after the advent of MTM in our organization.

Our division is one of eight divisions of the Robertshaw-Fulton Controls Company located throughout the United States. We employ approximately 1300 people and in January of this year moved into new quarters with 235,000 square feet of floor space.

We manufacture thermostats and control devices for the heating industry. Our principal product is thermostats for hot water heaters. Our production rate on these units amounts to several thousand per day. You can see by this volume that good methods are very important.

All of our direct labor, including foundry, plating, machine shop and assembly, is on a standard hour incentive plan, which has been in effect since 1946. Prior to World War II, piece rates were applied in certain departments.

Now, so much for background information, let's look at the story of MTM in assembly operations.

Prior to the use of MTM, we were facing the usual problems of Industrial Engineering and were hard pressed with these three.

1. Inability to adequately describe work methods so necessary with guaranteed incentive rates.

2. Difficulty in pre-planning assembly operations to assure line balance for flow purposes.

3. Estimates for cost purposes on proposed new products were not accurate enough. Quite often, costs determined from preliminary estimates were 10% to 15% and even more over or under the actual standards as established when the unit was in production.

Now I don't mean to infer that everything was in chaos with our methods and standards program and MTM saved the day. Up until the introduction of MTM in our company we had better than average control of methods and standards. This was not good enough for assembly operations.

On machinery and process operations, much of the job cycle time is controlled by the machine or process.

In assembly, practically all operations are manually controlled. It is imperative that these methods be so defined as to assure a sound standard, one that can be guaranteed.

We knew that, regardless of past errors in judgment on standards, MTM would not solve them. The advantages of MTM would come with its future use and not in the correction of past wrongs.

Up to this point I have been pointing out some general aspects of the problem. Here is a brief step by step procedure on how we use MTM to establish assembly standards for incentive purposes.

I'm not going to stress the application of MTM symbols to specific motions. I'm sure that you are more interested in how someone else uses MTM, what problems they encounter and how they solve them. With this thought in mind, I have picked a typical operation in our assembly and will use it as an example.

Let's assume this operation is ready for study then this procedure follows:

The Industrial Engineer contacts the foreman of the section or area where the operation is located. After informing the foreman of his proposed job study, together, they review the operation.

If the foreman agrees the operation is ready, then an MTM analysis is prepared. At this point, changes in method found necessary by the analysis are taught to the operator. When the method is satisfactory to the engineer, he contacts the foreman again to obtain approval of the final method. The foreman checks the description, watches the job for conformity and acknowledges his approval by signing the analysis sheet. (See Figure 1)

The engineer then prepares the MTM in detail (Figure 2) and upon completion prepares a time study form with a brief description of the operation. The time study form is then given to another engineer and an independent check study is made of the operation. After the time study and MTM have been summarized, they are compared element by element. (See Figure 2). Discrepancies are discussed by the engineers. When they are major, both engineers look at the job again and take corrective measures.

A time standard summary sheet is prepared (See Figure 3) showing all pertinent information. This sheet, along with the studies, is then taken to and discussed with the foreman. The foreman determines the effective date of the standard.

Before the standard is issued to the operating section, an Operation Detail Sheet is prepared (See Figure 4). One of these sheets is posted at each work station and describes the method, feeds, speeds and tools used; as well as shows the time standard and applicable part numbers. These operation sheets are kept current with all job changes.

To keep the operators informed on their daily progress, a Posting Sheet is prepared, summarizing the previous day's work record for each employee. (See Figure 5). This record is posted daily in each foreman's section and shows the previous day's work. Industrial Engineering uses this sheet to follow up on new standards as well as to spot discrepancies on established operations.

Now that we are using MTM to establish assembly standards is it paying off? There are many ramifications to this question. It is difficult to "nail down" the actual dollars and cents savings when comparing the use of MTM to time study. In our opinion, MTM standards are not "cheap." The initial cost of a standard, when using MTM, appears to be higher than that of conventional time study. However, in maintaining the standards there is a considerable saving of the engineers' time.

To point out these differences, a chart has been prepared (Figure 6) comparing the two systems of establishing standards. It is interesting to note that approximately the same amount of total time is spent on time study and MTM for new standards today as was in 1953, but considerably more time is spent on paper work and instructions.

On new standards, the total cost is 12% more with MTM than by time study. On the other hand, the total standards maintenance cost has been reduced 12% to 13%.

In general, we have found that MTM offers many advantages not necessarily associated with cost. Possibly you can call them intangibles. One of these is the confidence that the Standards Supervisor has in a standard set with MTM. Another is assurance that the engineers are establishing consistent standards. There are many more too numerous to mention.

The advantages of MTM are as follows:

1. Consistent elemental times from job to job for the same work.
2. Elimination or reduction of the possibility of operators changing job methods once the incentives are applied.
3. More confidence on the part of the standards engineer, especially when encountering new and different operations.
4. Cost savings resulting in better design of tools, fixtures, etc.
5. Speed and ease of adjusting MTM standards for minor or major element changes.
6. Concise and complete descriptions on operations so that method changes are recognizable.
7. Consistent and accurate cost estimates for tool planning and price determination.

The success of MTM in our organization can be attributed to these factors:

1. We train our engineers thoroughly in MTM. This includes not only the formal training but also job training under direct supervision.
2. We use MTM within its limitations. The stop watch is still very necessary.
3. Through the use of MTM we have been able to check the quality of work of each engineer and to take corrective measures when a weakness is discovered.

By following a few simple rules, MTM can be used successfully to solve your assembly problems.

Interesting applications of MTM handwriting analysis sometimes occur in Assembly Operations.

Simple mechanical aids allow simultaneous use of both hands, an example of one of the fundamental laws of motion economy.

Effective use of simultaneous motions where mechanical handling is not available can reduce assembly costs substantially.

Operator instruction in the proper method is an important phase of any MTM analysis leading to standards for incentive purposes.

LYNWOOD, CALIFORNIA

MTM ANALYSIS SHEET

ROBERTSHAW-FULTON CONTROLS COMPANY

INDUSTRIAL ENGINEERING DEPARTMENT

DATE 6-16-55

OBSERVER L. HAWKINS

OPERATOR Man ✓ Woman DICK KERR

DEPARTMENT 6

STUDY NO 1

WORK METHOD APPROVED BY B. Krow A

CLOCK NO 6682

EQUIPMENT

MACH. NO

PART NO. 19000 ET AL OPER NO. 110

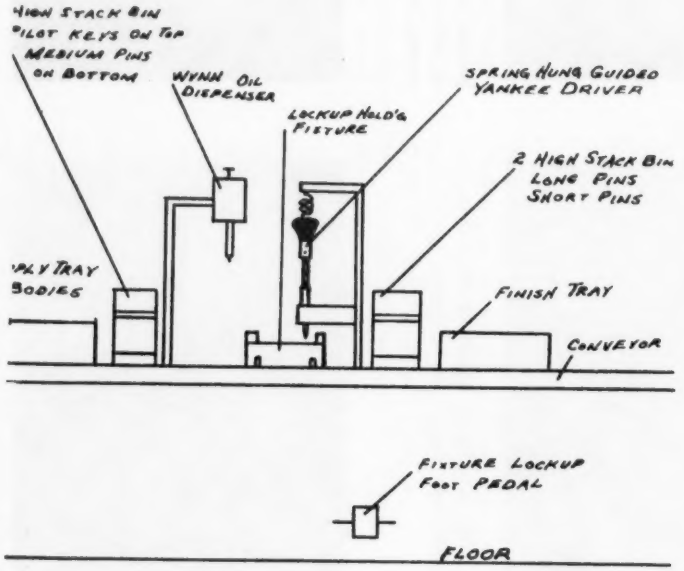
PART NAME MODEL 200 BODY ASS'Y.

OPER. DESCRIPTION GAGE SCREW EXTENSION

SPECIAL TOOLS, JIGS, FIXTURES, ETC.

FIXTURE 67-338
GAGE 76-806
ALIGNING FIXTURE 65-467
OILING FIXTURE 65-464

NOTES AND/OR REMARKS



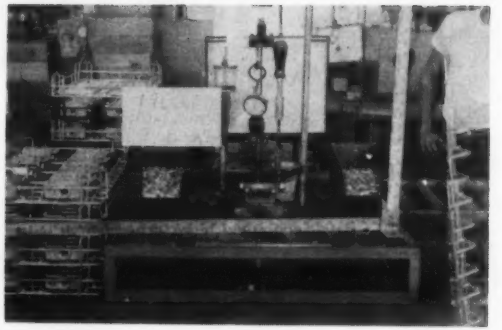


FIGURE I

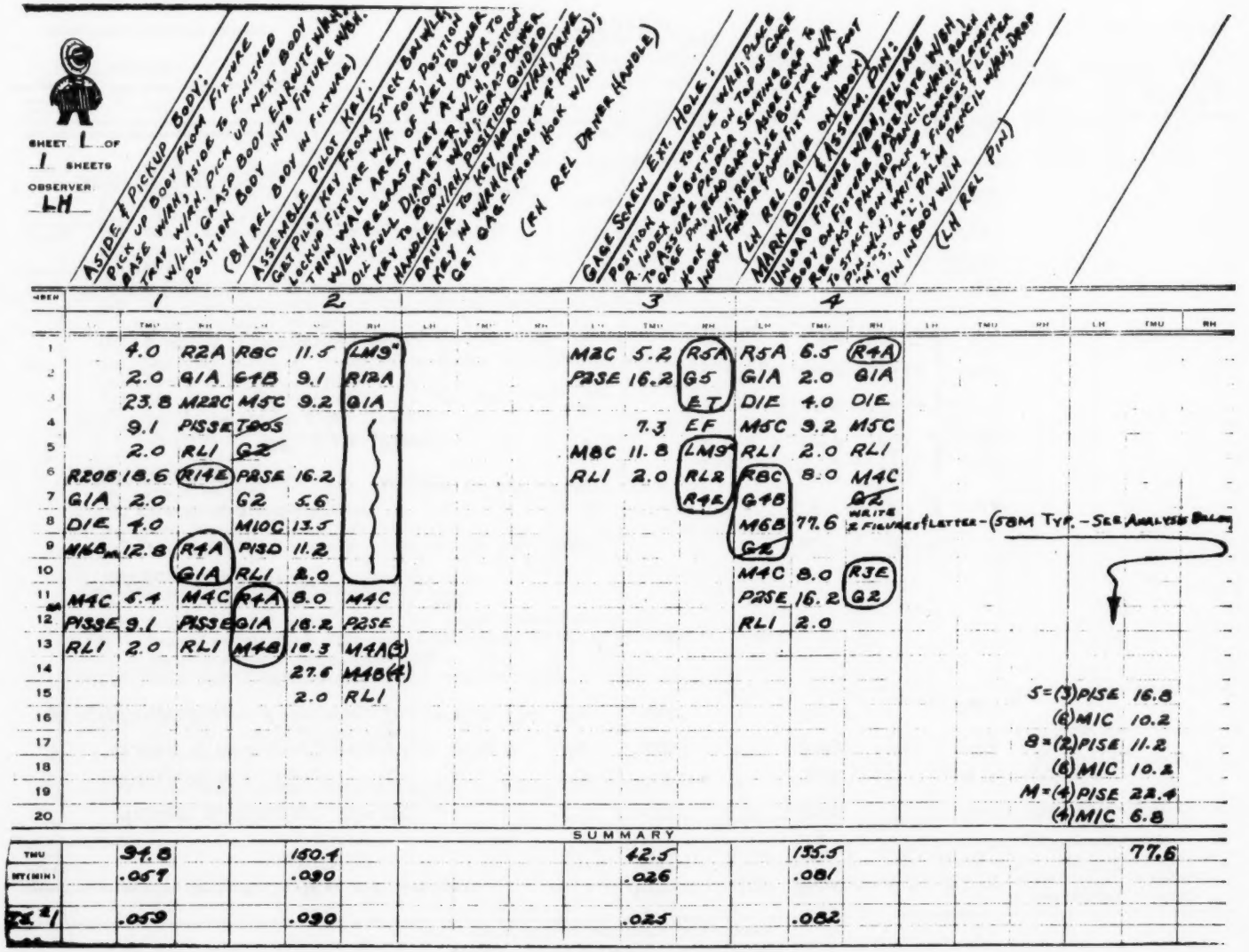

SHEET 1 OF 1 SHEETS
OBSERVER LH
ASIDE & PICKUP BODY:
PICK UP BODY FROM FIXTURE
BASE W/RH; ASIDE TO FINISHED
TRAY W/LH; PICK UP NEXT BODY
W/LH; GRASP BODY ENROUTE W/RH;
POSITION BODY IN FIXTURE W/RH.
(BH REL BODY IN FIXTURE)
ASSEMBLE PILOT KEY:
GET PILOT KEY FROM STACK BW/LH;
LOCKUP FIXTURE W/R FOOT, POSITION
THIN WALL AREA OF KEY TO CLEAR
W/LH, REGRASP KEY AT OAL TO
OIL FULL DIAMETER W/LH, POSITION
KEY TO BODY W/LH, GRASP DRIVER
HANDLE W/LH, POSITION GUIDED
DRIVER TO KEY HEAD W/RH, DRIVE
KEY IN W/RH (APPROX 4 "P" PASSES);
GET GAGE FROM HOOK W/LH
(RH REL DRIVER HANDLE)
GAGE SCREW EXT. HOLE:
POSITION GAGE TO HOLE W/LH; PLACE
R. INDEX ON BOTTOM TOP OF GAGE
TO ASSURE PROPER SEATING OF
GAGE PIN; READ GAGE; RELEASE
HOOK W/LH; RELEASE BUTTON W/R
INSPECT FOR FOREIGN MATERIAL
(LH REL GAGE ON HOOK)
MARK BODY & ASSEM. PIN:
UNLOAD FIXTURE W/RH; RELEASE
BODY ON FIXTURE W/RH; RELEASE
REGRASP PALMED PENCIL W/RH; RAISE
PIN W/LH; WRITE 2 FIGURES; CORRECT
"M", OR "L" PALM PENCIL W/RH; DROP
PIN IN BODY W/LH
(LH REL PIN)
WRITE 2 FIGURES/LETTER - (58M TYP. - SEE ANALYSIS BELOW)
S=(3)PISE 16.8
(2)MIC 10.2
8=(2)PISE 11.2
(2)MIC 10.2
M=(4)PISE 22.4
(4)MIC 6.8
1
2
3
4
SUMMARY
TMU
94.8
150.1
42.5
135.5
77.6
MT(MIN)
.057
.090
.026
.081
.059
.090
.025
.082

FIGURE 2

GRAYSON CONTROLS DIVISION
LONG BEACH, CALIF.

ROBERTSHAW-FULTON CONTROLS COMPANY

TIME STANDARD SUMMARY

INDUSTRIAL ENGINEERING DEPARTMENT

OPERATION DESCRIPTION: GAGE SCREW EXTENSION — PART NAME: MODEL 200 BODY ASS'Y — PART NO.: 19000 — OPER. NO.: 110

ELEMENT NO.	ELEMENT DESCRIPTION	UNIT MEAS.	NORMAL TIME	EFFORT FATIGUE	STANDARD TIME	CONV. FACTOR	STD. TIME PER PROD. UNIT	THIS STD ALSO APPLIES TO: PART NO.	OPER.	DATE	BY
1	ASIDE & PICKUP BODY	Pc	.057	115	.066	1/1	.066	19001	110	6-17-55	LH
2	ASSEMBLE PILOT KEY	Pc	.090	"	.104	1/1	.104	19002	"	"	"
3	GAGE SCREW EXTENSION HOLE	Pc	.026	"	.030	1/1	.030	19003	"	"	"
4	MARK BODY & ASSEM. SCREW EXT. PIN	Pc	.081	"	.094	1/1	.094				
	MISC. ELEMENTS:										
	JOT COUNT	OCC			.05	1/8	-				
	EXCHANGE TRAY	"			.11	1/8	.020				
	REPLENISH PILOT KEYS	"			.384	1/700	-				
	" "M" EXT. PINS	"			.384	1/700	.001				
	" "S" " "	"			.384	1/10,000	-				
	" "L" " "	"			.384	1/10,000	.001				
	" WYNN'S OIL	"			.384	1/10,000	-				

REASON FOR REVISION

ORIGINAL: NEW

REV. 1

REV. 2

REV. 3

STD. MIN./PC.	3	2	1
STD. HOURS/100 PC			.316
PIECES PER HOUR			.53
DATE COMPILED			189
ENGINEER			6-17-55

SEE ADDITIONAL NOTES ON REVERSE SIDE

FORM

PAGE 1 OF 1

FIGURE 3

GRAYSON CONTROLS DIVISION

OPERATION DETAIL SHEET

ISSUED BY INDUSTRIAL ENGINEERING DEPARTMENT

ROBERTSHAW-FULTON CONTROLS COMPANY

SUPERSEDED ISSUE OF 6-3-55 | DEPT. 6
DATE 6-17-55 6-24-55 8-29-55

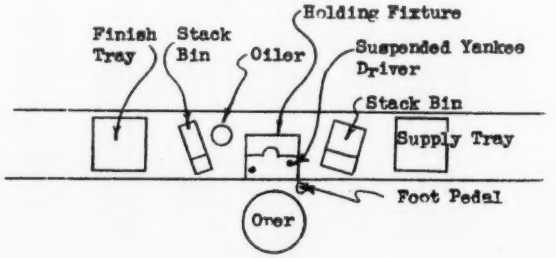
PART NAME MODEL #700 BODY ASSEMBLY
LABOR GRADE 12 OPER. NO. 110
OPERATION DESCRIPTION Gage Screw Extension

PART NUMBER	STD. HRS. 100 PCS.	PCS./HR.
19000	.53	189
19001	.53	189
19002	.53	189
19003	.53	189

NO.	JOB ELEMENTS	FEED & SPEED
1	ASIDE AND PICK UP BODY: (a) Grasp and aside body to finished tray w/LH (b) Pick up next body w/RH (c) Grasp next body enroute to fixture w/LH (d) Load body into fixture w/RH	
2	ASSEMBLE PILOT KEY: (a) Get pilot key from stack bin w/LH; actuate foot pedal w/R foot to lockup fixture (b) Position thin wall area of key to oiler w/LH (c) Turn key at oiler 1 rev. w/LH; grasp Yankee driver w/RH (d) Position key in body w/LH (e) Drive key into body w/RH; get gage from hook w/LH NOTE: Key to be driven flush w/edge of body (Approx. 4, 3" to 4" passes)	
3	GAGE SCREW EXTENSION HOLE: (a) Position gage to body w/LH; place R index finger on button on top of indicator dial (b) Read gaged dimension and pin size (c) Aside gage to hook w/LH; open fixture w/R foot	
4	MARK BODY AND ASSEMBLE SCREW EXTENSION PIN: (a) Grasp body and unload fixture w/RH (b) Regrasp palmed pencil and write gaged dimension and pin length on gas cock body boss w/RH; reach to stack bin and pick up correct length pin w/LH (c) Palm pencil w/RH; position pin into body w/LH	
	MISC. ELEMENTS: (a) Jot count and exchange trays (b) Replenish parts (c) Replenish Wynnes oil NOTE: This Detail Sheet written for flow of parts from Right to Left, for opposite side, reverse motions	

TOOLS & GAGES NAME	No.
Fixture	67-338
Gage	76-806
A-10 Stack Bins (4)	Std.
26" Metal Stool	Std.
Tray	147-27
Detail Sheet Holder	153-163
Set Block	87-330
Oil Container w/	Std.
Wynnes Oil w/	Std.
Fixture	65-464
China Marker (Black) #163 T	Std.
Yankee screwdriver #135	Std.
w/Yankee Bit #3512 w/	Std.
Assembly Tool	130-268
Pilot key aligning Fixt.	65-467

WORK STATION SKETCH



FORM G-02 DMYD

FIGURE 4

GP-56

GRAYSON CONTROLS, Division Assembly - Hartman

DAILY POSTING REPORT

Date 11-1-54

DEPT.	EMP. NO.	EMPLOYEE NAME	SEC.	PART NUMBER	OPER. NO.	PIECES	ACCOUNT NUMBER	ACTUAL HOURS	STD. HRS. PRODUCED	INDEX	HRS. BELOW STANDARD	BONUS HOURS	AMOUNT
1028		EARL GIBSON	3							*			*
1028		111	3	11726	30	2400	101	27	30				498
1028		111		41042	20	3320	101	52	73				1212
1028		111					104					24	398
								79	103	* 131			* 1710
1039		ROBERT THOMASON	3							*			*
1039		111	3	11719	17	3181	101	20	31				515
1039		111		65559	40	5935	101	58	71				1179
1039		111					104					24	398
								78	102	* 131			* 1694
1040		111	3				122						42
1040		111		19638	10	550	1011	30					498
										*			* 498
1042		ALVA B DYER	3							*			*
1042		111	3				209	5					107
1042		111					122						136
1042		111		94531	30	19500	101	75	113				2430
1042		111					104					38	817
								75	113	* 150			* 2537
1044		111	3	41117	30	2065	101	79	120				2136
1044		111					104					41	730
								79	120	* 152			* 2136
1045		JOSEPH BRACHAKO	3							*			*
1045		111	3	19667	510	1940	101	80	89				1691
1045		111					104					9	171
								80	89	* 111			* 1691
1046		JOHN V VOLAK	3							*			*
1046		111	3	11390	10	1765	101	79	118				2242
1046		111					104					39	741
								79	118	* 150			* 2242
1049		LLOYD R AHL	3							*			*
1049		111	3	16134	20	105	101	14	17				266
1049		111		16134	30	105	101	18	21				342
1049		111		16096	20	59	101	20	8				380
1049		111		16026		18	224	6					114
1049		111		16096	20	114	101	21	15				399
1049		111					101		1				
1049		111					315				11		
								73	62	* 85			* 1501

FIGURE 5

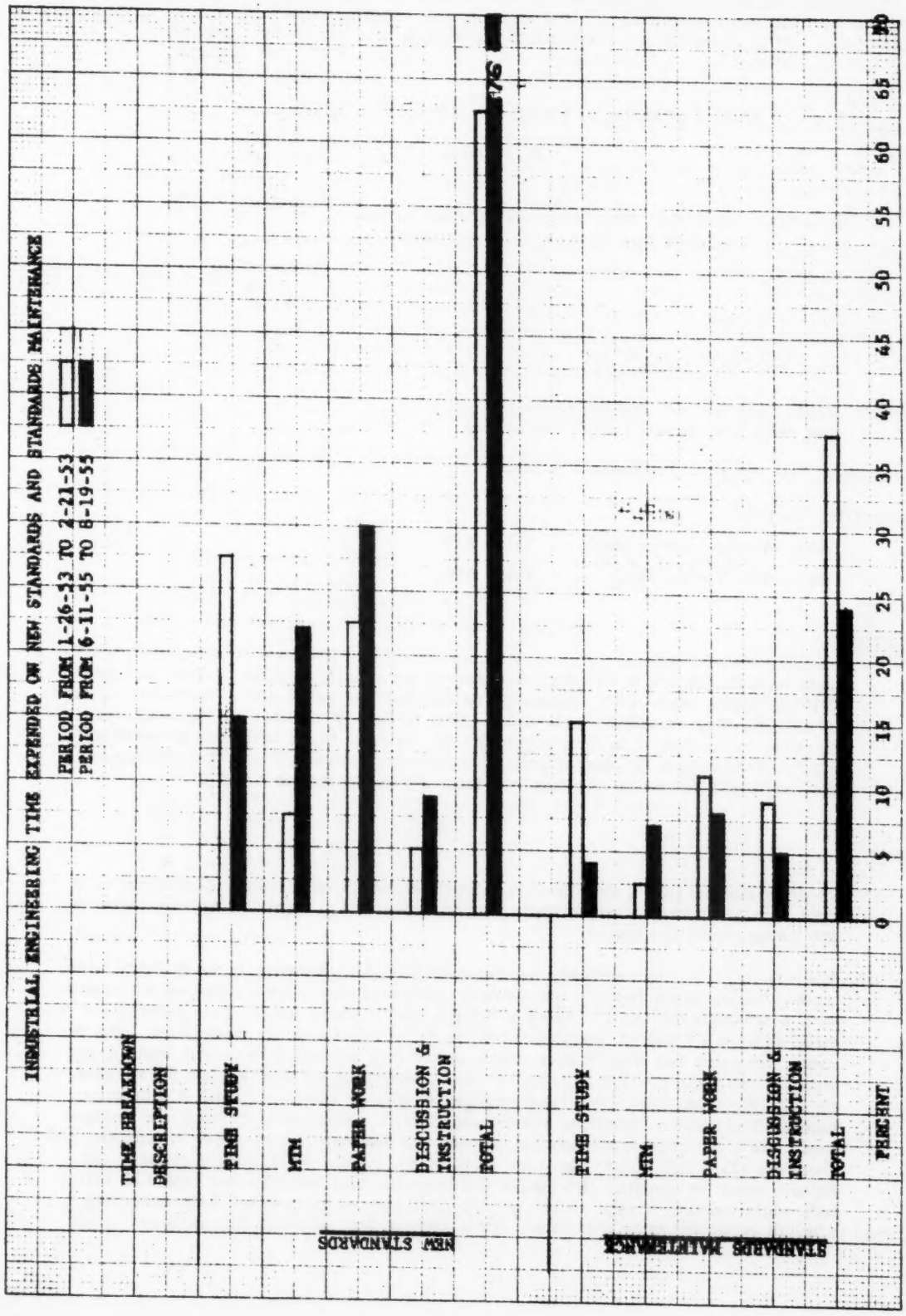

INDUSTRIAL ENGINEERING TIME EXPENDED ON NEW STANDARDS AND STANDARDS MAINTENANCE
PERIOD FROM 1-26-53 TO 2-21-53
PERIOD FROM 6-11-55 TO 8-19-55
TIME BREAKDOWN
DESCRIPTION
NEW STANDARDS
TIME STUDY
MEN
PAPER WORK
DISCUSSION & INSTRUCTION
TOTAL
STANDARDS MAINTENANCE
TIME STUDY
MEN
PAPER WORK
DISCUSSION & INSTRUCTION
TOTAL
PERCENT
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
97%

FIGURE 6

APPLICATION

II

TIME FORMULA APPLIED TO MACHINING OPERATIONS

W. Holmes

(Editor's Note: Following many requests for time formulae, the "Journal" submits this formula as an example.)

Formula Gear Dept. #30
December 12, 1955

PART: Cam and Crank Gears

OPERATION: Drill, Chamfer and Tap Puller Holes
Spot Drill Timing Mark When Necessary.

WORK STATION: (4) Spindle Drill Press - I-5779

ALLOWED TIME IN TMU:

Gears Without Timing Mark - Table XIII

Gears With Timing Mark - - Table XIV

APPLICATION:

This formula applies to drilling, chamfering and tapping of puller holes, and spot drilling timing mark when necessary, on all cam and crank gears which are covered by the following conditions: (1) puller holes to be 3/8"-16 thread, (2) weight range of gears to be from 0 to 12-1/2 pounds, (3) material to be cast iron or steel bar stock, (4) thickness of gear at puller hole to range from 1/2 to 1-1/2 inclusive, (5) that feeds and speeds be the same as those shown on Tables I and II.

ANALYSIS:

The operator obtains a gear from tote box and places it in timing mark fixture, or lays it on drill press table between #1 and #2 spindles, depending upon whether or not timing mark is required.

(A) When timing mark is required, the remainder of the procedure is as follows: After loading timing mark fixture, the operator spot drills the timing mark on #1 spindle with a 1/8 diameter drill. He then unloads timing mark fixture and asides piece on table between #1 and #2 spindles, stepping to #2 spindle at the same time. He unloads piece that has been drilled, from puller hole drilling fixture and loads it in chamfer-tap fixture which is lying on drill press table between #2 and #3 spindles. He then picks up piece from table between #1 and #2 spindles, loads it into puller hole drilling fixture, positions fixture under drill, brings drill to work and engages feed. Next he steps to #3 spindle, moving chamfer-tap fixture under #3 spindle, and chamfers (2) puller holes. He then steps to #4 spindle while sliding chamfer-tap fixture under #4 spindle. He gets brush from oil can, oils tap and taps 1st. puller hole while palming brush. After tapping first hole he moves 2nd. hole under tap, oils tap again and taps 2nd. hole. While tapping 2nd. hole he returns brush to oil

ANALYSIS: (Continued) can (it will probably be necessary, during the tapping cycle, to step back to #2 spindle, move drill fixture to 2nd. hole, engages feed to drill 2nd. hole and step back to #4 spindle. Where this will occur will depend upon the thickness of the gear, type of material, etc.) After tapping (2) holes, he gets thread gage from holder and gages (1) tapped hole with go and no-go end of gage, once every (10) pieces. In doing this, he must be sure that the entire thread on go end of gage passes thru the tapped hole, as required by Inspection Department. He then steps to between #2 and #3 spindles, sliding chamfer-tap fixture to between #2 and #3 spindles at the same time. He unloads chamfer-tap fixture, asides finished piece in tote box and at this point obtains rough piece (Note: Single tote box is used for rough and finished pieces, two rows being left open when tote box is brought to drill press by day-worker.

(B) When timing mark is not required, the operator, after laying piece on table from tote box, goes directly to #2 spindle. He then unloads drill fixture, loads piece in chamfer fixture, picks up piece from table and loads it in drill fixture. He then follows the same work cycle, as described in paragraph (A), from this point on. The foreman instructs operator as to which part is to be processed depending upon schedules released to him by the Production Scheduling Department. Rough stock is brought to the operation by a laborer and finish parts are removed by same.

TIME FORMULA EXPRESSION

C = Total of elements, constant to all parts, not performed on process time.

X = Time for drilling (2) puller holes = $2\left[\left(\frac{L}{RF} \div .01\right) \div .0006\right]$

Where:-

2 = No. of holes drilled
R = R.P.M. of spindle
L = Total length of cut
F = I.F.P.R.
.01 = Time for spindle retraction
.0006 = Conversion factor from minutes into TMU

Y = Total of elements performed on process time ÷ time for tapping (2) puller holes =

$$E_p \div 2 \left[1.5 \left(\frac{16L}{R} \div .006\right) \div .0006\right]$$

Where:-

E_p = Total of elements performed on process time
2 = No. of holes tapped
1.5 = Time for tapping in and out (twice as fast tapping out)
16 = Constant for threads/inch.
L = Total length of cut
R = R.P.M. of spindle
.006 = Time for tap spindle to reverse
.0006 = Conversion factor from minutes into TMU

Z = Allowed time for gaging

$$Z = \frac{G - (X-Y)}{10} \quad \text{when } X > Y$$

$$Z = Y \div \frac{G}{10} \quad \text{when } Y > X$$

Where: -

G = Total time for gaging
10 = Occurrence of 1/10 for gaging

THEREFORE: -

Time allowed = 1.10 (C ÷ X or Y, whichever is greater, ÷ Z)

Where:-

1.10 = Total time ÷ 10% allowance for fatigue, personal, and unavoidable delays.

DWG. No.

PART DESCRIPTION	MATERIAL
CAM & CRANK GEARS 1/2 TO 1¼ THICK AT PULLER HOLE & WEIGHING FROM 0-2½ POUNDS	CAST IRON OR STEEL BAR STOCK

OPERATION DRILL CHAMFER & TAP PULLER HOLES; SPOT DRILL TIMING MARK OPER. NO. 50

LOCATION BAY 618

OPERATOR

MAN MACHINE | NAME F. JONES | NO. 2151

EQUIPMENT (4) SPINDLE DRILL PRESS # I-5779

SPECIAL TOOLS 1" PAINT BRUSH AND 3/8-16 DOUBLE END THREAD GAGE

CONDITIONS NORMAL

QUALITY REQUIREMENTS ENTIRE LENGTH OF "GO" THREAD GAGE MUST ENTER TAPPED PULLER HOLE

STUDIED BY W. Holmes | APPROVED BY

SKETCHES (EQUIPMENT, TOOLS, PARTS, WORK PLACE LAYOUT, ETC.)

SEE ATTACHED SHEET #24 & 25 FOR SKETCHES

METHODS ANALYSIS CHART

REFERENCE No. GEAR DEPT. 30

PART CAM & CRANK GEARS DATE 12/12/55 STUDY No. Time Formula

OPERATION DRILL & TAP PULLER HOLES - DRILL TIMING MARK ANALYST W. Holmes SHEET No. 5 OF 27 SHEETS

DESCRIPTION — LEFT HAND	No.	L H	TMU	R H	No.	DESCRIPTION — RIGHT HAND
(1) POSITION FIXTURE UNDER #2			SPINDLE &	DRILL TO WORK		
FIXTURE UNDER DRILL		M10C	13.5	(R18A)		TO SPINDLE LEVER
FIXTURE BUSHING TO DRILL		P1SE	5.6	(G5)		ON LEVER
			6.1	M4A		SPINDLE DOWN
				~~G2~~		CLOSE FINGERS ON LEVER
			16.2	API		ENGAGE FEED
ON FIXTURE		(RL1)		(RL1)		ON LEVER
			41.4			
(2) DRILL TIMING MARK						
TO TIMING MARK FIXTURE		(R18A)	14.9	R24A		TO SPINDLE LEVER
				~~SS10CT~~		TO #1 SPINDLE
LAY HAND ON FIXTURE		G5	0	G5		ON LEVER
			8.0	M4C		SPINDLE DOWN
				~~G2~~		CLOSE FINGERS ON LEVER
			16.2	API		SPOT DRILL TIMING MARK
REMOVE HAND FROM FIXTURE		(RL2)	2.0	RL1		ON LEVER
			41.1			
(3) UNLOAD TIMING MARK FIXTURE & ASIDE PIECE ON TABLE						
TO GEAR IN FIXTURE		(R6A)	8.7	R10A		TO GEAR IN FIXTURE
ON GEAR		G1A	2.0	G1A		ON GEAR
ON GEAR		(RL1)		M12B		GEAR TO TABLE
HAND OUT OF WAY		(R6E)				
			2.0	RL1		GEAR ON TABLE
			12.7			

METHODS ANALYSIS CHART

Reference No. GEAR DEPT. #30

Part CAM & CRANK GEARS Date 12/12/55 Study No. TIME FORMULA

Operation DRILL & TAP PULLER HOLES — DRILL TIMING MARK Analyst W. Holmes Sheet No. 6 of 27 Sheets

Description – Left Hand	No.	Le He	THU	Re He	No.	Description – Right Hand
(4) IDLE TIME						CALCULATED
(5) DRILL 1ST. PULLER HOLE						
PROCESS TIME						
(6) SHIFT DRILL FIXTURE TO 2ND. HOLE & DRILL TO WORK						
TO DRILL FIXTURE ON TABLE		(R14B)	16.7	R28A		TO SPINDLE LEVER
				SSNCI		TO #2 SPINDLE
ON FIXTURE		G1A	2.0	G5		ON LEVER
FIXTURE BUSHING UNDER DRILL		M5C	9.2			
ALIGN BUSHING WITH DRILL		PISE	5.6			
			6.1	M4A		SPINDLE DOWN
				G2		CLOSE FINGERS ON LEVER
			16.2	API		ENGAGE FEED
ON FIXTURE		(RL1)		(RL1)		ON LEVER
			55.8			
(7) MOVE CHAMFER FIXTURE TO #3 SPINDLE & CHAMFER 1ST. PULLER HOLE						
TO CHAMF. FIXTURE ON TABLE		(R14B)	16.7	R28A		TO SPINDLE LEVER
				SSNCI		TO #3 SPINDLE
ON FIXTURE		G1A	2.0	G1A		ON LEVER
1ST. HOLE TO CHAMFER TOOL		M12C	15.2			
ALIGN HOLE WITH TOOL		PISE	5.6			
			6.1	M4A		SPINDLE DOWN
			16.2	API		CHAMFER 1ST. HOLE
			6.1	M4A		SPINDLE UP
			67.9			

METHODS ANALYSIS CHART

Reference No. GEAR DEPT. #30

Part CAM & CRANK GEARS Date 12/12/55 Study No. TIME FORMULA

Operation DRILL & TAP PULLER HOLES — DRILL TIMING MARK Analyst W. Holmes Sheet No. 7 of 27 Sheets

Description – Left Hand	No.	Le He	THU	Re He	No.	Description – Right Hand
(8) MOVE CHAMFER FIXTURE TO 2ND. POSITION & CHAMFER 2ND. PULLER HOLE						
2ND. HOLE TO CHAMFER TOOL		M5C	9.2			
ALIGN HOLE WITH TOOL		PISE	5.6			
			6.1	M4A		SPINDLE DOWN
			16.2	API		CHAMFER 2ND. HOLE
			6.1	M4A		SPINDLE UP
			2.0	RL1		ON SPINDLE LEVER
			45.2			
(9) DRILL 2ND. PULLER HOLE						
PROCESS TIME						
(10) MOVE CHAMFER FIXTURE TO #4 SPINDLE & OIL TAP						
FIXTURE TO #4 SPINDLE		(M16B)	16.7	R28A		TO SPINDLE LEVER
				SSNCI		TO #4 SPINDLE
ON FIXTURE		RL1	2.0	G1A		ON LEVER
TO BRUSH IN OIL CAN		R14B	14.4			
ON BRUSH		G1A	2.0			
BRUSH TO TAP		M16B	15.8			
			50.9			

METHODS ANALYSIS CHART

Reference No. GEAR DEPT. #30

Part CAM & CRANK GEARS Date 12/12/55 Study No. TIME FORMULA

Operation DRILL & TAP PULLER HOLES, DRILL TIMING MARK Analyst W. HOLMES Sheet No. 8 of 27 Sheets

Description – Left Hand	No.	Le/Ri	THU	Le/Ri	No.	Description – Right Hand
(11) POSITION FIXTURE UNDER TAP & TAP 1ST. PULLER HOLE						
TO FIXTURE	R8B		10.1			
PALM BRUSH	~~GE~~					
ON FIXTURE	G1A		2.0			
1ST. HOLE UNDER TAP	M3C		6.7			
ALIGN 1ST. HOLE WITH TAP	P1SE		5.6			
			6.7	M3C		SPINDLE DOWN
			4.9	M3A		SPINDLE UP
			36.0			
(12) MOVE FIXTURE TO 2ND. POSITION & TAP 2ND. HOLE						
2ND. HOLE UNDER TAP	M5C		9.2			
ALIGN 2ND. HOLE WITH TAP	P1SE		5.6			
			6.7	M3C		SPINDLE DOWN
			4.9	M3A		SPINDLE UP
			2.0	R1I		ON LEVER
			7.9	R8A		TO GEAR IN FIXTURE
			2.0	G1A		ON GEAR
			38.3			
(13) TAP (2) PULLER HOLES & ASIDE BRUSH						
PROCESS TIME						
HAND OFF OF FIXTURE	(R1I)					
BRUSH TO OIL CAN	M16B					
BRUSH IN OIL CAN	R1I					
HAND BACK IN POSITION	R12E					

METHODS ANALYSIS CHART

Reference No. GEAR DEPT. #30

Part CAM & CRANK GEARS Date 12/12/55 Study No. TIME FORMULA

Operation DRILL & TAP PULLER HOLES, DRILL TIMING MARK Analyst W. HOLMES Sheet No. 9 of 27 Sheets

Description – Left Hand	No.	Le/Ri	THU	Le/Ri	No.	Description – Right Hand
(14) MOVE FIXTURE TO BETWEEN #2 & #3 SPINDLES & UNLOAD FINISHED PIECE						
TO GEAR IN FIXTURE	(R10A)		23.0	SS22C1		TO #2 SPINDLE WITH FIXTURE
ON GEAR	G1A			~~R6T~~		ON GEAR IN FIXTURE
GEAR OFF OF LOCATOR	M4B					
			18.6	TBC1		TO TOTE BOX
GEAR TO STACK IN TOTE BOX	M18C			(B10E)		HAND IN NEXT POSITION
ON GEAR	R1I		2.0			
			43.6			
(15) GET ROUGH PIECE & LOAD TO TIMING MARK FIXTURE						
HAND OUT OF WAY	(R8E)		10.1	R8B		TO ROUGH PIECE IN TOTE BOX
			2.0	G1A		ON ROUGH PIECE
			18.6	TBC1		TO #1 SPINDLE
				M10C		ROUGH PIECE TO FIXTURE
			10.4	P1NSE		ROUGH PIECE IN FIXTURE
			2.0	R1I		ON ROUGH PIECE
			43.1			
(16) STEP TO #2 SPINDLE & UNLOAD DRILL FIXTURE						
TO BUSHING PLATE	R11B		12.2	(R12E, SS10C1)		GET HAND IN POSITION TO #2 SPINDLE
ON BUSHING PLATE	G1A		2.0			
FIXTURE AWAY FROM SPINDLE	M6B		8.9	(R5A, G1A)		TO PIECE IN FIXTURE, ON PIECE IN FIXTURE
BUSHING PLATE UP	~~M4A~~					
			23.1			

METHODS ANALYSIS CHART

Reference No. GEAR DEPT. # 30

Part CAM & CRANK GEARS Date 12/12/55 Study No. TIME FORMULA

Operation DRILL & TAP OILER HOLES DRILL TIMING MARK Analyst W. Holmes Sheet No. 10 of 27 Sheets

Description - Left Hand	No.	LaHa	TMU	ReHa	No.	Description - Right Hand
(17) LOAD FINISHED DRILLED PIECE TO CHAMFER FIXTURE						
				TBC1		NOT CHARGED
ON BUSHING PLATE		R1I		AM4C		DRILLED PIECE TO CHAMFER FIXTURE
HAND IN POSITION		R10E	10.4	PINSE		DRILLED PIECE IN FIXTURE
			2.0	R1I		PIECE TO FIXTURE
			12.4			
(18) LOAD PIECE FROM TABLE TO DRILL FIXTURE						
TO GEAR ON TABLE		R6B	11.4	R16A		TO HINGED BUSHING PLATE
ON GEAR		G1A	2.0	G5		ON BUSHING PLATE
GEAR TO LOCATOR		M10C				
GEAR ON LOCATOR		PINSE	10.4			
ON GEAR		R1I	4.9	M3A		BUSHING PLATE DOWN
TO FIXTURE		R6B	8.6	R12		ON BUSHING PLATE
ON FIXTURE		G1A	2.0			
			39.3			
(19) GET THREAD GAGE & GAGE TAPPED HOLE WITH NO GO END						
TO FIXTURE ON TABLE		R6B	11.4	R16A		TO THREAD GAGE IN HOLDER
ON FIXTURE		G1A	2.0	G1A		ON THREAD GAGE
FIXTURE AWAY FROM TAP		M8D	16.9	M14C		GAGE TO TAPPED HOLE
			16.2	P2SE		GAGE IN TAPPED HOLE
			30.0	T75M	4	
			32.4	API	2	
			4.0	R1I	2	TRY NO GO GAGE
			9.6	T75S	2	
			4.0	G1A	2	
			4.6	M2B		GAGE OUT OF HOLE
			131.1			

METHODS ANALYSIS CHART

Reference No. GEAR DEPT. # 30

Part CAM & CRANK GEARS Date 12/12/55 Study No. TIME FORMULA

Operation DRILL & TAP OILER HOLES DRILL TIMING MARK Analyst W. Holmes Sheet No. 11 of 27 Sheets

Description - Left Hand	No.	LaHa	TMU	ReHa	No.	Description - Right Hand
(20) GAGE TAPPED HOLE WITH "GO" END OF GAGE & ASIDE GAGE						
			16.8	G2	3	TURN GAGE END FOR END
			8.0	M4C		GO END TO TAPPED HOLE
			16.2	P2SE		GAGE IN TAPPED HOLE
			530.0	T120M	50	
			96.0	R1I	48	GAGE IN & OUT OF
			326.5	T120	48	TAPPED HOLE
			96.0	G1A	48	
ON FIXTURE		R1I	20.4	M18C		GAGE TO HOLDER
			2.0	R1I		GAGE IN HOLDER
			1111.9			
(21) GET ROUGH PIECE FROM TOTE BOX & LAY ON TABLE						
HAND OUT OF WAY		R8E	10.1	R8B		TO ROUGH GEAR IN TOTE BOX
			2.0	G1A		ON GEAR
				M10B		GEAR OUT OF TOTE BOX
			18.6	TBC1		TO #1 SPINDLE
			2.0	R1I		GEAR ON TABLE
			32.7			
(22) STEP TO DRILL FIXTURE FOR INDEXING & RETURN TO POSITION						
			20.6	SS18C1		TO #2 SPINDLE
			20.6	SS18C1		RETURN TO POSITION
			9.6	R12A		TO TAP SPINDLE LEVER
			2.0	G1A		ON LEVER
			52.8			

OPERATION SUMMARY

PART Cam & Crank Gears — DATE 12/12/55 — STUDY No. Time Formula
OPERATION Drill, Chamfer & Tap Puller Holes; Drill Timing Mark — ANALYST W. Holmes — SHEET No. 12 OF 27 SHEETS

No.	Element Description	Analysis Chart Ref. Sheet	Element Time TMU	Conversion Factor / Leveled Time	% Allowance	Element Time Allowed	Occurrences per Piece or Cycle	Total Time Allowed
1	Position fixture under #2 spindle & drill to mark		41.4				1	
2	Drill timing mark		41.1				1	
3	Unload timing mark fixture & aside piece on table		26.1	(plus weight allowance)			1	
4	Idle time		Calculation				1	
5	Drill 1st. puller hole		Process time				1	
6	Shift fixture to 2nd. hole & drill to mark		55.8				1	
7	Move chamfer fixture to #3 spindle & chamfer 1st. puller hole		67.9				1	
8	Move chamfer fixture to 2nd. position & chamfer 2nd. puller hole		45.2				1	
9	Drill 2nd. puller hole		Process time				1	
10	Move chamfer fixture to #4 spindle & oil tap		50.9				1	
11	Position fixture under tap & tap 1st. puller hole		36.0				1	
12	Move fixture to 2nd. position & tap 2nd. hole		38.3				1	
13	Tap (2) puller holes & aside brush		Process time on drill time				1	
14	Move fixture to between #2 & #3 spindles & unload finished piece		43.6	(plus weight allowance)			1	
15	Get rough piece & load to timing mark fixture		43.1	(plus weight allowance)			1	
16	Step to #2 spindle & unload drill fixture		23.1				1	
17	Load finished drilled piece to chamfer fixture		12.4	(plus weight allowance)			1	
18	Load piece from table to drill fixture		39.3	(plus weight allowance)			1	

I.E. W.T.M. 8M-8
Prepared & distributed by Manufacturing Research.

TOTAL TIME ALLOWED PER _____

OPERATION SUMMARY

PART Cam & Crank Gears — DATE 12/12/55 — STUDY No. Time Formula
OPERATION Drill, Chamfer & Tap Puller Holes; Drill Timing Mark — ANALYST W. Holmes — SHEET No. 13 OF 27 SHEETS

No.	Element Description	Analysis Chart Ref.	Element Time TMU	Conversion Factor / Leveled Time	% Allowance	Element Time Allowed	Occurrences per Piece or Cycle	Total Time Allowed
19	Get thread gage & gage tapped hole with "No Go" end		131.1				1/10	
20	Gage tapped hole with "Go" end of gage & aside gage		1111.9				1/10	
21	Get rough piece from tote box & lay on table		32.7	(plus weight allowance)			1	
22	Step to drill fixture for inspection & return to position		58.8				1	

I.E. W.T.M. 8M-8
Prepared & distributed by Manufacturing Research.

TOTAL TIME ALLOWED PER _____

TABLE OF CONSTANTS AND VARIABLES
GEARS WITHOUT TIMING MARK

FORMULA GEAR DEPT. #30
DECEMBER 12, 1955
SHEET 14 OF 27 SHEETS

ELEMENT NO.	CONSTANT OR VARIABLE	INFLUENCING FACTOR	CLASSIFICATION
1	CONSTANT		USE FOR ALL PARTS
4	VARIABLE	CALCULATION	
5	VARIABLE	THICKNESS & MATERIAL	PROCESS TIME
6	CONSTANT		USE FOR ALL PARTS
7	CONSTANT		PERFORMED DURING PROCESS TIME
8	CONSTANT		PERFORMED DURING PROCESS TIME
9	VARIABLE	THICKNESS & MATERIAL	PROCESS TIME
10	CONSTANT		PERFORMED DURING PROCESS TIME
11	CONSTANT		PERFORMED DURING PROCESS TIME
12	CONSTANT		PERFORMED DURING PROCESS TIME
13	VARIABLE	THICKNESS & MATERIAL	PROCESS TIME
14	VARIABLE	WEIGHT	PERFORMED DURING PROCESS TIME
16	CONSTANT		USE FOR ALL PARTS
17	VARIABLE	WEIGHT	PERFORMED DURING PROCESS TIME
18	VARIABLE	WEIGHT	USE FOR ALL PARTS
19	CONSTANT		GAGING TIME
20	CONSTANT		GAGING TIME
21	VARIABLE	WEIGHT	PERFORMED DURING PROCESS TIME
22	CONSTANT		PERFORMED DURING PROCESS TIME

TABLE OF CONSTANTS AND VARIABLES
GEARS WITH TIMING MARK

FORMULA GEAR DEPT #30
DECEMBER 12, 1955
SHEET 15 OF 27 SHEETS

ELEMENT NO.	CONSTANT OR VARIABLE	INFLUENCING FACTOR	CLASSIFICATION
1	CONSTANT		USE FOR ALL PARTS
2	CONSTANT		USE FOR ALL PARTS
3	VARIABLE	WEIGHT	PERFORMED DURING PROCESS TIME
4	VARIABLE	CALCULATION	
5	VARIABLE	THICKNESS & MATERIAL	PROCESS TIME
6	CONSTANT		USE FOR ALL PARTS
7	CONSTANT		PERFORMED DURING PROCESS TIME
8	CONSTANT		PERFORMED DURING PROCESS TIME
9	VARIABLE	THICKNESS & MATERIAL	PROCESS TIME
10	CONSTANT		PERFORMED DURING PROCESS TIME
11	CONSTANT		PERFORMED DURING PROCESS TIME
12	CONSTANT		PERFORMED DURING PROCESS TIME
13	VARIABLE	THICKNESS & MATERIAL	PROCESS TIME
14	VARIABLE	WEIGHT	PERFORMED DURING PROCESS TIME
15	VARIABLE	WEIGHT	PERFORMED DURING PROCESS TIME
16	CONSTANT		USE FOR ALL PARTS
17	VARIABLE	WEIGHT	PERFORMED DURING PROCESS TIME
18	VARIABLE	WEIGHT	USE FOR ALL PARTS
19	CONSTANT		GAGING TIME
20	CONSTANT		GAGING TIME

FORMULA GEAR DEPT. #30
DECEMBER 12, 1955
SHEET 16 OF 27 SHEETS

TABLE I

TIME FOR DRILLING (2) 5/16 DIAMETER TAP HOLES

		THICKNESS OF GEAR AT OUTER HOLE								
		1/2	5/8	3/4	7/8	1"	1 1/8	1 1/4	1 3/8	1 1/2
CUTTING TIME IN THOU	CAST IRON	336.6	446.6	496.6	550.0	601.6	653.4	705.0	756.6	808.2
	STEEL	643.4	732.0	816.6	906.6	994.0	1081.4	1168.6	1256.0	1343.4

$$\text{CUTTING TIME IN THOU} = 2\left(\frac{\text{LENGTH OF CUT}}{\text{RPM} \times \text{IFPR}} + .01\right) \div .0006$$

LENGTH OF CUT = THICKNESS + DIA. OF DRILL + .0625*

.01 = TIME FOR SPINDLE RETRACTION

RPM FOR CAST IRON = 1344

RPM FOR STEEL = 745

IFPR = .006 FOR BOTH CAST IRON & STEEL

* .0625 = CONSTANT FOR VARIATION IN THICKNESS OF STOCK

FORMULA GEAR DEPT. #30
DECEMBER 12, 1955
SHEET 17 OF 27 SHEETS

TABLE II

TIME FOR TAPPING (2) 3/8-16 TAPPED HOLES

		THICKNESS OF GEAR AT OUTER HOLE								
		1/2	5/8	3/4	7/8	1"	1 1/8	1 1/4	1 3/8	1 1/2
CUTTING TIME IN THOU	CAST IRON	153.6	171.6	189.6	207.6	225.6	243.6	261.6	279.6	297.6
	STEEL	183.6	206.0	227.6	244.0	271.0	293.0	315.0	336.6	358.0

$$\text{CUTTING TIME IN THOU} = 2\left[1.5\left(\frac{\text{LENGTH OF CUT} \times 16}{\text{RPM}}\right) + .006\right] \div .0006$$

LENGTH OF CUT = THICKNESS + DIA. OF TAP + .0625

RPM FOR CAST IRON = 560

RPM FOR STEEL = 458

16 = CONSTANT FOR THREADS PER INCH

.006 = TIME FOR TAP SPINDLE TO REVERSE

USE 1.5 MULTIPLIER FOR TAPPING IN & OUT (TWICE AS FAST TAPPING OUT)

TABLE III

ELEMENT 3 — TIME ALLOWED = 13.4 (F) + C

WHERE: 13.4 = CONSTANT FOR M12B
F = WEIGHT FACTOR FROM DATA CARD
C = CONSTANT FROM DATA CARD

WEIGHT OF GEAR	TIME ALLOWED
0-2 1/2 *	13.4
2 1/2-7 1/2	16.4
7 1/2-12 1/2	18.9

TABLE IV

ELEMENT 15 — TIME ALLOWED = 13.5 (F) + C

WHERE: 13.5 = CONSTANT FOR M10C
F = WEIGHT FACTOR FROM DATA CARD
C = CONSTANT FROM DATA CARD

USE FOR ELEMENT 18 ALSO

WEIGHT OF GEAR	TIME ALLOWED
0-2 1/2 *	13.5
2 1/2-7 1/2	16.5
7 1/2-12 1/2	18.9

FORMULA GEAR DEPT. #30
DECEMBER 12, 1955
SHEET 18 OF 27 SHEETS

FORMULA GEAR DEPT. #30
DECEMBER 12, 1955
SHEET 19 OF 27 SHEETS

TABLE V

ELEMENT 14 — TIME ALLOWED = (6.9 F + C) + (20.4 F + C)

WHERE: 6.9 = CONSTANT FOR M4B
20.4 = CONSTANT FOR M1BC
F = WEIGHT FACTOR FROM DATA CARD
C = CONSTANT FROM DATA CARD

WEIGHT OF GEAR	TIME ALLOWED
0-2 1/2 *	27.3
2 1/2-7 1/2	33.3
7 1/2-12 1/2	38.1

TABLE VI

ELEMENT 17 — TIME ALLOWED = 16.9 (F) + C

WHERE: 16.9 = CONSTANT FOR M14C
F = WEIGHT FACTOR FROM DATA CARD
C = CONSTANT FROM DATA CARD

WEIGHT OF GEAR	TIME ALLOWED
0-2 1/2 *	16.9
2 1/2-7 1/2	20.1
7 1/2-12 1/2	22.7

FORMULA GEAR DEPT. #30
DECEMBER 12, 1955
SHEET 20 OF 27 SHEETS

TABLE VII

ELEMENT 21 ~ TIME ALLOWED = 12.2 (F) + C
WHERE : 12.2 = CONSTANT FOR MICB
F = WEIGHT FACTOR FROM DATA CARD
C = CONSTANT FROM DATA CARD

WEIGHT OF GEAR	TIME ALLOWED
0-2 1/2 #	12.2
2 1/2 - 7 1/2	15.1
7 1/2 - 12 1/2	17.4

FORMULA GEAR DEPT. #30
DECEMBER 12, 1955
SHEET 21 OF 27 SHEETS

TABLE VIII

FOR GEARS WITH OR WITHOUT TIMING MARK
TOTAL OF CONSTANT TIME FOR ALL PARTS

TIME ALLOWED = EL. 1 + EL. 6 + EL. 16 + EL. 18 + TABLE IV
= 159.6 + TABLE IV

WEIGHT OF GEAR	TIME ALLOWED
0-2 1/2 #	173.1
2 1/2 - 7 1/2	176.1
7 1/2 - 12 1/2	178.5

TABLE IX

FOR GEARS WITHOUT TIMING MARK
TOTAL OF ELEMENTS PERFORMED DURING PROCESS TIME

TIME ALLOWED = EL. 7 + EL. 8 + EL. 10 + EL. 11 + EL. 12 + EL. 14
+ TABLE V + EL. 17 + TABLE VI + EL. 21 + TABLE VII + EL. 22
= 313.8 + TABLE V + TABLE VI + TABLE VII

WEIGHT OF GEAR	TIME ALLOWED
0-2 1/2 #	436.2
2 1/2 - 7 1/2	448.3
7 1/2 - 12 1/2	458.0

FORMULA GEAR DEPT. #30
DECEMBER 12, 1955
SHEET 22 OF 27 SHEETS

TABLE X

FOR GEARS WITH TIMING MARK
TOTAL OF CONSTANTS PERFORMED ON PROCESS TIME

TIME ALLOWED = EL. 2 + EL. 3 + TABLE III + EL. 7 + EL. 8
+ EL. 10 + EL. 11 + EL. 12 + EL. 14 + TABLE V
+ EL. 15 + TABLE IV + EL. 17 + TABLE VI + EL. 22
= 444.0 + TABLE III + TABLE IV + TABLE V
+ TABLE VI

WEIGHT OF GEAR	TIME ALLOWED
0-2 1/2 #	515.1
2 1/2 - 7 1/2	530.3
7 1/2 - 12 1/2	542.6

FORMULA GEAR DEPT. #30
DECEMBER 12, 1955
SHEET 23 OF 27 SHEETS

TABLE XI

FOR GEARS WITHOUT TIMING MARK
TOTAL OF CONSTANTS PERFORMED ON PROCESS + TIME FOR TAPPING (2) HOLES
TIME ALLOWED = TABLE II + TABLE IX

WEIGHT OF GEAR	TYPE OF MATERIAL	THICKNESS OF GEAR AT PULLER HOLE								
		1/2	5/8	3/4	7/8	1"	1 1/8	1 1/4	1 3/8	1 1/2
0-2 1/2	CAST IRON	589.8	607.8	625.8	643.8	661.8	679.8	697.8	715.8	733.8
	STEEL	619.8	642.2	663.8	685.2	707.2	729.2	751.2	772.2	794.2
2 1/2 - 7 1/2	CAST IRON	601.9	619.9	637.9	655.9	673.9	691.9	709.9	727.9	745.9
	STEEL	631.9	654.3	675.9	697.3	719.3	741.3	763.3	784.3	806.3
7 1/2 - 12 1/2	CAST IRON	611.6	629.6	647.6	665.6	683.6	701.6	719.6	737.6	755.6
	STEEL	641.6	664.0	685.6	707.0	729.0	751.0	773.0	794.0	816.0

TABLE XII

FOR GEARS WITH TIMING MARK
TOTAL OF CONSTANTS PERFORMED ON PROCESS + TIME FOR TAPPING (2) HOLES
TIME ALLOWED = TABLE II + TABLE X

WEIGHT OF GEAR	TYPE OF MATERIAL	THICKNESS OF GEAR AT PULLER HOLE								
		1/2	5/8	3/4	7/8	1"	1 1/8	1 1/4	1 3/8	1 1/2
0-2 1/2	CAST IRON	668.7	686.7	704.7	722.7	740.7	758.7	776.7	794.7	812.7
	STEEL	698.7	721.1	742.7	764.1	786.1	808.1	830.1	851.1	873.1
2 1/2 - 7 1/2	CAST IRON	683.9	701.9	719.9	737.9	755.9	773.9	791.9	809.9	827.9
	STEEL	713.9	736.3	757.9	779.3	801.3	823.3	845.3	866.3	888.3
7 1/2 - 12 1/2	CAST IRON	696.2	714.2	732.2	750.2	768.2	786.2	804.2	822.2	840.2
	STEEL	726.2	748.6	770.2	791.6	813.6	835.6	857.6	878.6	900.6

TABLE XIII

TOTAL TIME FOR GEARS WITHOUT TIMING MARK

INCLUDES 10% ALLOWANCE FOR FATIGUE, PERSONAL, & UNAVOIDABLE DELAYS

WEIGHT OF GEAR	TYPE OF MATERIAL	THICKNESS OF GEAR AT PULLER HOLE								
		1/2	5/8	3/4	7/8	1"	1 1/8	1 1/4	1 3/8	1 1/2
0 - 2 1/2 #	CAST IRON	975.9	995.7	1015.5	1035.3	1055.1	1074.9	1094.7	1154.9	1208.0
	STEEL	1032.2	1122.4	1208.6	1300.1	1389.0	1478.0	1566.7	1655.0	1744.5
2 1/2 - 7 1/2	CAST IRON	992.5	1012.3	1032.1	1051.9	1071.7	1091.5	1111.3	1159.5	1212.6
	STEEL	1036.9	1127.1	1213.2	1304.7	1393.6	1482.6	1571.4	1660.1	1749.1
7 1/2 - 12 1/2	CAST IRON	1005.8	1025.6	1045.4	1065.2	1085.0	1104.8	1124.6	1163.2	1216.3
	STEEL	1040.6	1130.8	1216.9	1308.3	1397.3	1486.3	1575.0	1663.9	1752.9

DERIVATION: TIME FROM TABLE I OR XI - WHICHEVER IS THE GREATER TIME ALLOWED

FORMULA GEAR DEPT. #30 DECEMBER 12, 1955 SHEET 24 OF 29 SHEETS

WHEN TABLE XI IS GREATER:

$$\text{TOTAL TIME} = 1.10\left[\text{TABLE VIII} + \text{TABLE XI} + \frac{(\text{EL. 19} + \text{EL. 20})}{10}\right]$$

WHEN TABLE I IS GREATER:

$$\text{TOTAL TIME} = 1.10\left[\text{TABLE VIII} + \text{TABLE I} + \frac{(\text{EL.19} + \text{EL.20}) - (\text{TABLE I} - \text{TABLE XI})}{10}\right]$$

TABLE XIV

TOTAL TIME FOR GEARS WITH TIMING MARK

INCLUDES 10% ALLOWANCE FOR FATIGUE, PERSONAL & UNAVOIDABLE DELAYS

WEIGHT OF GEAR	TYPE OF MATERIAL	THICKNESS OF GEAR AT PULLER HOLE								
		1/2	5/8	3/4	7/8	1"	1 1/8	1 1/4	1 3/8	1 1/2
0-2 1/2 #	CAST IRON	1062.7	1082.5	1102.3	1122.1	1141.9	1161.7	1181.5	1201.3	1221.1
	STEEL	1095.7	1131.1	1217.3	1308.7	1397.7	1486.7	1575.3	1664.2	1753.2
2 1/2 - 7 1/2	CAST IRON	1082.7	1102.5	1122.3	1142.1	1161.9	1181.7	1201.5	1221.3	1241.1
	STEEL	1115.7	1140.4	1222.2	1313.7	1402.6	1491.6	1580.4	1669.1	1758.1
7 1/2 - 12 1/2	CAST IRON	1098.9	1118.7	1138.5	1158.3	1178.1	1197.9	1217.7	1237.5	1257.3
	STEEL	1131.9	1156.5	1226.3	1317.7	1406.7	1495.6	1584.3	1673.2	1762.1

DERIVATION: TIME FROM TABLE I OR XII, WHICHEVER IS THE GREATER TIME ALLOWED

FORMULA GEAR DEPT. #30 DECEMBER 12, 1955 SHEET 25 OF 29 SHEETS

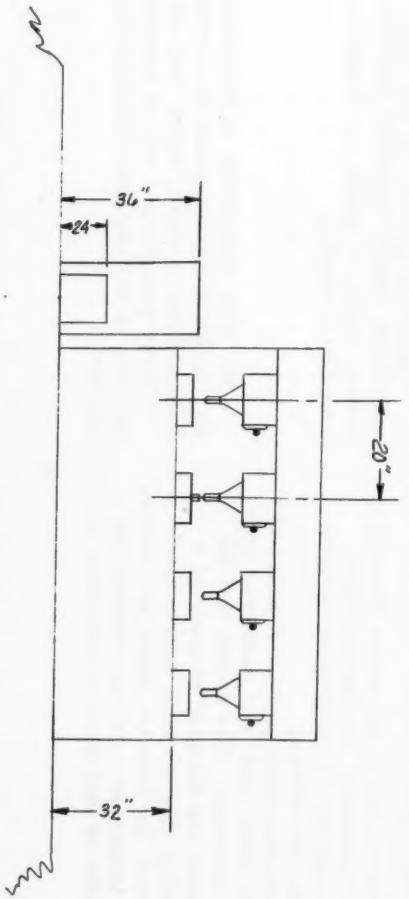
WHEN TABLE XII IS GREATER:

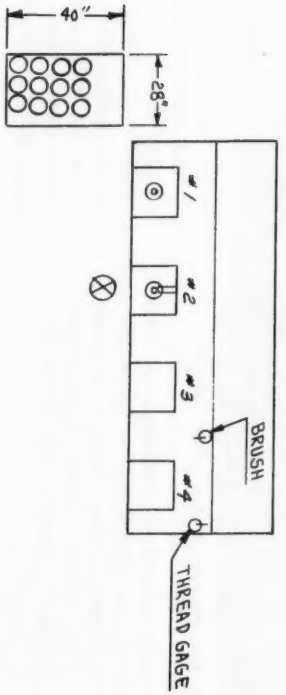
$$\text{TOTAL TIME} = 1.10\left[\text{TABLE VIII} + \text{TABLE XII} + \frac{(\text{EL. 19} + \text{EL. 20})}{10}\right]$$

WHEN TABLE I IS GREATER:

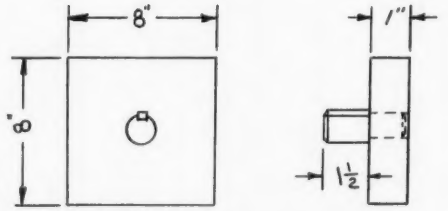
$$\text{TOTAL TIME} = 1.10\left[\text{TABLE VIII} + \text{TABLE I} + \frac{(\text{EL. 19} + \text{EL. 20}) - (\text{TABLE I} - \text{TABLE XII})}{10}\right]$$

FORMULA GEAR DEPT. #30
DECEMBER 2, 1955
SHEET 26 OF 27 SHEETS

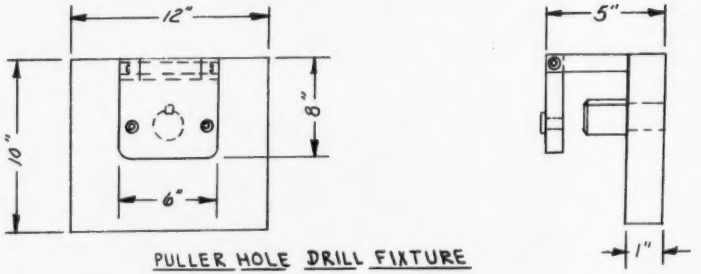




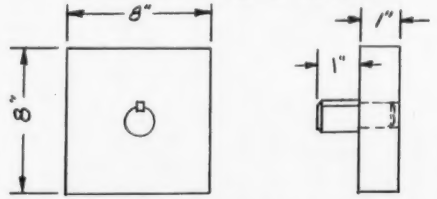
FORMULA GEAR DEPT. #30
DECEMBER 12, 1955
SHEET 27 OF 27 SHEETS



TIMING MARK DRILL FIXTURE



PULLER HOLE DRILL FIXTURE



COMBINATION CHAMFER-TAP FIXTURE

MTM NEWS

DAYTON AIR FORCE DEPOT GRADUATES MTM PRACTITIONERS

In an informal ceremony Colonel Leon W. Armour, Deputy Commander, presented certificates to 11 Dayton Air Force Depot personnel for successful completion of the Methods Time Measurement Practitioner's Course, the first of its kind to be completed in Dayton, and the first in the government in the State of Ohio, it was announced today by Brigadier General Leslie G. Mulzer, Depot Commander.

The course consisted of 105 hours of study on procedures and methods involved in the time measurement system. Mr. John West, Chief, Industrial Engineering Division of the Directorate of Supply and Services, conducted the class. He pointed out the fact that this is a very rigid schedule, and if an individual misses as much as 2 classes he might as well drop out as it is almost impossible to catch up once they get behind. He also pointed out that approximately 100 additional hours of home work is required to successfully complete this course.

Colonel Armour commended Mr. West and the students as 85 percent of the entire class successfully completed the course which, in accordance with the National Standards, is a very high average.

The present plans are to continue this training and it is anticipated that the top supervisors will be given the course in the near future.

The following personnel completed the course: Lt. Carl J. Wyles, Lt. Otis T. Blake, Lowell E. Mesarvey, Jr., Robert Sutton, Alvin J. Bonham, Jean Cassel, John Leiser, James H. Hannegan, Edwin Durr, Dallas T. Huddle, and Gerald B. Hanby.

CHAPTER NEWS

CENTRAL IOWA ASSOCIATION

Mr. Walter E. Brown, Executive Vice-President, Kiowa Corporation, Marshallton, Iowa, spoke on the subject, "Time Keeping by Telephone," at the May meeting.

Mr. Brown described in detail a means of accounting for time, kind, and quantity of work produced by operators. The system that Mr. Brown developed and installed is based on a unique adaptation of a telephone-intercom network over which line foremen report job changes to a central timekeeper. Having observed the cost and results of four years of operation, he was well qualified to evaluate the effectiveness of this system.

CINCINNATI OHIO CHAPTER

A Materials Handling Study was the subject of the May meeting in Cincinnati. Mr. Lloyd Durward, Industrial Engineer, Campbell-Hausfeld Company, presented an actual study. MTM was utilized in the study to analyze and evaluate.

SOUTHERN CALIFORNIA CHAPTER

Fred Fisher, Benjamin Borchardt and Associates, discussed the topic, "Automation, Work Measurement, and MTM." Mr. Fisher discussed the effect of Automation and its associated high degree of electronic instrumentation and control in the field of industrial engineering. The above topic was presented at the May Meeting.

In June, the Chapter presented a panel on "MTM in Heavy Industry." Bill Greenbacker, General Motors Corporation, Kenneth Patton, Modine Manufacturing Company, and Bob Edgecumbe, Virtue Brothers Manufacturing Company, were panel members. All three of these members are department heads in their own concerns, and each is concerned with a type of manufacture where heavy weights are handled manually in a great many operations. The application of MTM to these operations was the subject for discussion.

ST. LOUIS CHAPTER

The June meeting presentation on "The Learning Curve as a Production Tool" was given by Robert W. Baronovic, Senior Planner, Statistics, McDonnell Aircraft Corporation.

An introductory discussion of "Man Power Control Techniques" was made by S. B. Sponder, United States Defense Corporation.

TORONTO CHAPTER

Mr. James Lee, Clarkson Refinery, spoke on "Industrial Oil" at the May meeting.

"Materials Handling Selection and Procurement of Equipment" was discussed by Bill Porter, Henry A. Martin and Associates, at the June Dinner Meeting.

* * *

The MTM Association wishes to acknowledge the receipt of regular Research contributions from Chapter members during May and June.

These contributions aid the Association in carrying on the important research work at the University.

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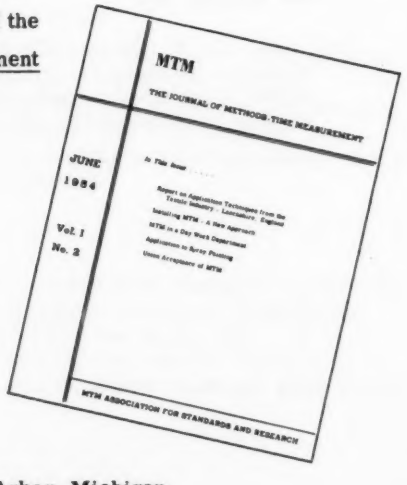

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A talk presented at the SAM-ASME Time and Motion Study Conference, April 1952. It contains an analysis of performance rating systems and various performance Rating Films from an MTM standpoint.

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This report represents almost two man-years' work on a study of Simultaneous Motions. It is a final report of the Simultaneous Motions project undertaken by the MTM Association. While it does not purport to provide complete and exhaustive answers to all problems in the field of Simultaneous Motions, it presents a great deal of new and valuable information which should be of interest to every MTM practitioner.

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